Coordination and Data Management of the International Arctic Buoy Programme (IABP)

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http://IABP.apl.washington.edu/

LONG-TERM GOALS

To maintain a research quality database of direct measurements and analyzed fields of surface air temperature (SAT), sea level pressure (SLP), ice motion and other geophysical quantities in the Arctic Basin using drifting buoys.

OBJECTIVES

- Coordinate resources to maintain a network of drifting buoys in the Arctic Basin that measure SLP, SAT and other geophysical quantities.

- Maintain a research quality database of these observations.

- Study possible improvements in the analyzed geophysical fields.

APPROACH

The IABP is a collaboration between 25 different institutions from 8 different countries, which work together to maintain a network of drifting buoys in the Arctic Ocean to provide meteorological and oceanographic data for research purposes and real-time operational requirements, including support to the World Climate Research Programme (WCRP) and the World Weather Watch (WWW) Programme.

Coordination of the IABP falls into the categories of resource management and meeting planning. Resource management is focused on matching buoy hardware and deployment opportunities to maintain the buoy network. The Participants of the IABP meet once each year to coordinate their resources.

Data management consists providing the IABP data to both the research and operational communities. The data are collected and analyzed at the Polar Science Center (PSC), which produces data sets of SAT, SLP and ice motion for research in Arctic meteorology, oceanography and climate. These data sets are described in journal articles and annual data reports. The data from the IABP are distributed operationally to the global telecommunication system, and are used to forecast weather and ice conditions.

The data are archived at the World Data Center, but primary distribution of the data sets has been through the IABP web server maintained at PSC (http://IABP.apl.washington.edu). Figure 1 shows the positions of buoys in September 2002, with the sea ice concentration map obtained from the National Center for Environmental Prediction.

WORK COMPLETED

Since 1979, an average of 25 buoys per year have been deployed. During this past fiscal year, 24 buoys were deployed, maintaining an array of 38 buoys through out the Arctic (Fig. 1).

Our latest efforts to improve the IABP databases have been directed towards producing a new SAT analysis which combines data from the buoys with data from land stations using the objective analysis procedure, optimal interpolation. This new SAT analysis is documented in a paper that has been published in the *Journal of Climate* (Rigor, et al., 2000). The data has been incorporated into a Global SAT climatology (Jones, et al. 1998) and has been included on the Environmental Working Group, Arctic Ocean Meteorology and Sea Ice digital atlases.

RESULTS

Using this SAT dataset, variations in SAT were studied. We show that there was a 2°C/decade warming over the eastern Arctic Ocean as well as a lengthening of the melt season of the sea ice from 1979 – 1997 (Figure 2). We show that these variations in SAT are related to the Arctic Oscillation (Thompson and Wallace, 1998), which accounts for more than 50% of the trends in SAT over much of the Arctic region.

IMPACT/APPLICATIONS

Dramatic changes in Arctic climate have been noted during the past two decades. Observations from the IABP have played a significant role in the detection of this change over the Arctic Ocean. For example, using IABP data:

1.) Walsh et al. (1996) showed that atmospheric pressure has decreased,

2.) Rigor et al. (2000) showed that air temperatures have warmed (Figure2), and

3.) In concert, the circulation of sea ice and the ocean have changed so as to flow less clockwise (Steele and Boyd, 1998; Kwok, 2000; and Rigor et al. 2002).

In addition to studies of Arctic climate and climate change, observations from the IABP are also used to validate satellites, for forcing, validation and assimilation into numerical climate models, and for forecasting weather and ice conditions.

TRANSITIONS

Using IABP data, Rigor et al. (2002) showed that the memory of the wintertime AO persists through the following spring, summer and fall. Specifically spring and fall SAT, and summer ice concentrations are all highly correlated to the prior winter AO index. We hope to take advantage of these high correlations to predict summer sea ice conditions given our knowledge of the prior winter weather.

RELATED PROJECTS

1- The North Pole Environmental Observatory (NPEO) deploys buoys in collaborations with IABP. We are also working with K. Falkner to determine the origin of water samples taken at the NPEO.

2- R. L. Colony (International Arctic Research Center, University of Alaska Fairbanks) and I are studying the annual cycle of SLP, SAT and ice motion.

3- J. Richter-Menge (Cold Regions Research and Engineering Laboratory) and I are working to deploy buoys enhanced with ice mass balance sensors throughout the Arctic Basin.

4- S. Pfirman (Columbia University) and I are studying the interannual variability in the transport pathways of sea ice produced in the Siberian Seas.

5- J. M. Wallace (University of Washington) and I are studying interannual variation in the IABP data in relation to the Arctic Oscillation, and are applying what we have learned to the prediction of summer sea ice conditions.

REFERENCES

Jones, P.D., M. New, D.E. Parker, S. Martin, and I.G. Rigor, Surface air temperature and its changes over the past 150 years, Rev. of Geophysics, v. 37, no. 2, pp. 173 - 199, 1999.

Kwok, R, Recent changes in the Arctic Ocean sea ice motion associated with the North Atlantic Oscillation, Geophys. Res. Lett., 27(6), 775-778, 2000.

Rigor, I.G., J.M. Wallace, and R.L. Colony, On the response of sea ice to the Arctic Oscillation, J. Climate, v. 15, no. 18, pp. 2648 - 2668, 2002.

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Steele, M. and T. Boyd, Retreat of the cold halocline layer in the Arctic Ocean, *J. Geophys. Res., 103*, 10,419-10,435, 1998.

Thompson, D. W. J., and J. M. Wallace, The Arctic Oscillation signature in the wintertime geopotential height and temperature fields, Geophys. Res. Let., v. 25, no. 9, pp 1297-1300, 1998.

Walsh, J. E., W. L. Chapman, and T. L. Shy, Recent decrease of sea level pressure in the central Arctic, J. Climate, v. 9, no. 2, pp. 480-485, February 1996.

PUBLICATIONS

The following list includes selected publications using IABP data. The data from the IABP has been used in over 400 research studies. For a list of these citations, please visit http://IABP.apl.washington.edu/Citations/.

Jones, P.D., M. New, D.E. Parker, S. Martin, and I.G. Rigor, Surface air temperature and its changes over the past 150 years, Rev. of Geophysics, v. 37, no. 2, pp. 173 - 199, 1999.

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Rigor, I., and M. Ortmeyer, International Arctic Buoy Program 2002 Data Report, APL-UW TM 4- 02, Applied Physics Laboratory, University of Washington, 2002.

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Steele, M. and T. Boyd, Retreat of the cold halocline layer in the Arctic Ocean, *J. Geophys. Res., 103*, 10,419-10,435, 1998.

Walsh, J. E., W. L. Chapman, and T. L. Shy, Recent decrease of sea level pressure in the central Arctic, J. Climate, v. 9, no. 2, pp. 480-485, February 1996.

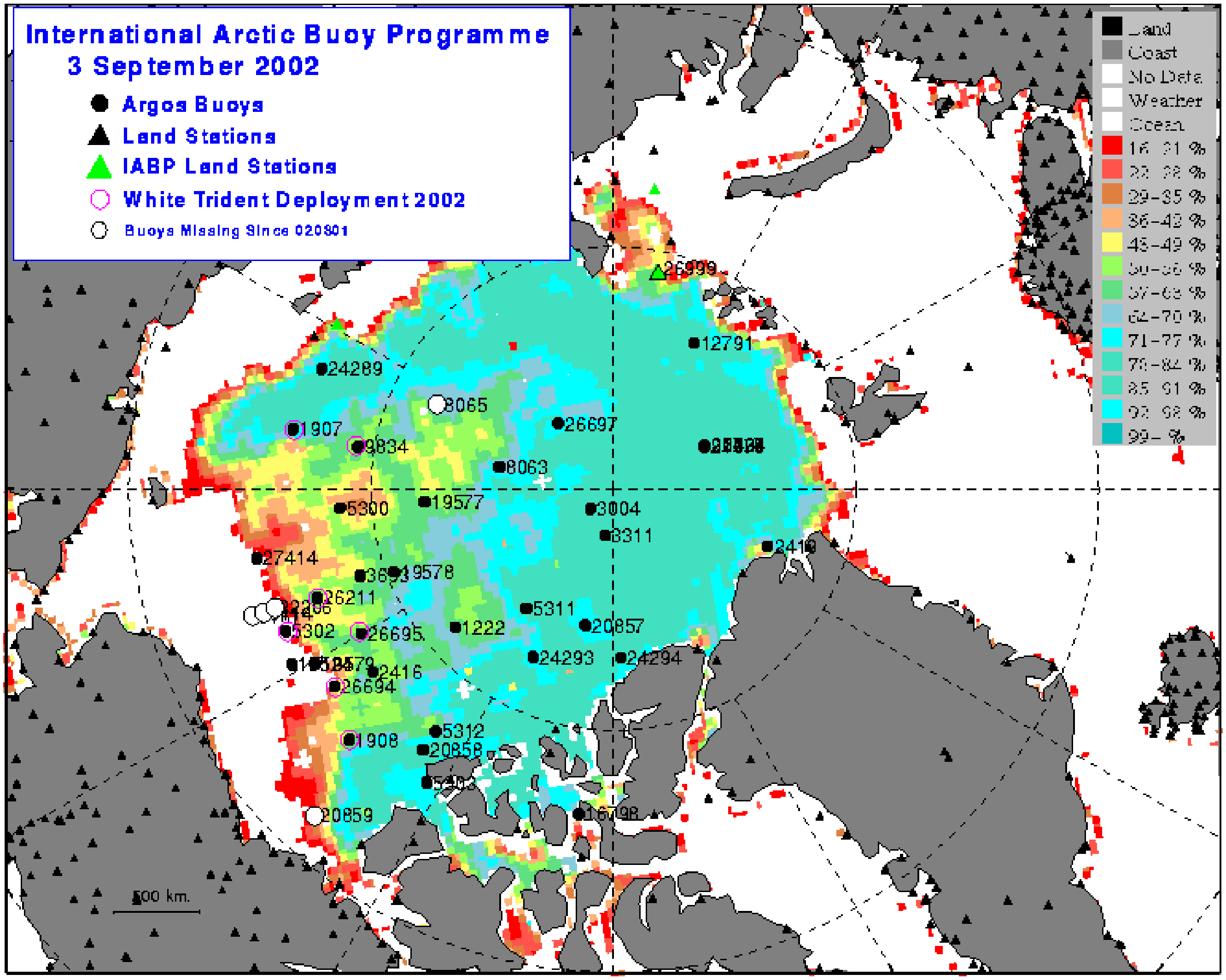

Figure 1. On September 3, 2002, 38 buoys (black dots) were reporting in the Arctic Basin. The NCEP sea ice concentrations analysis is also shown.

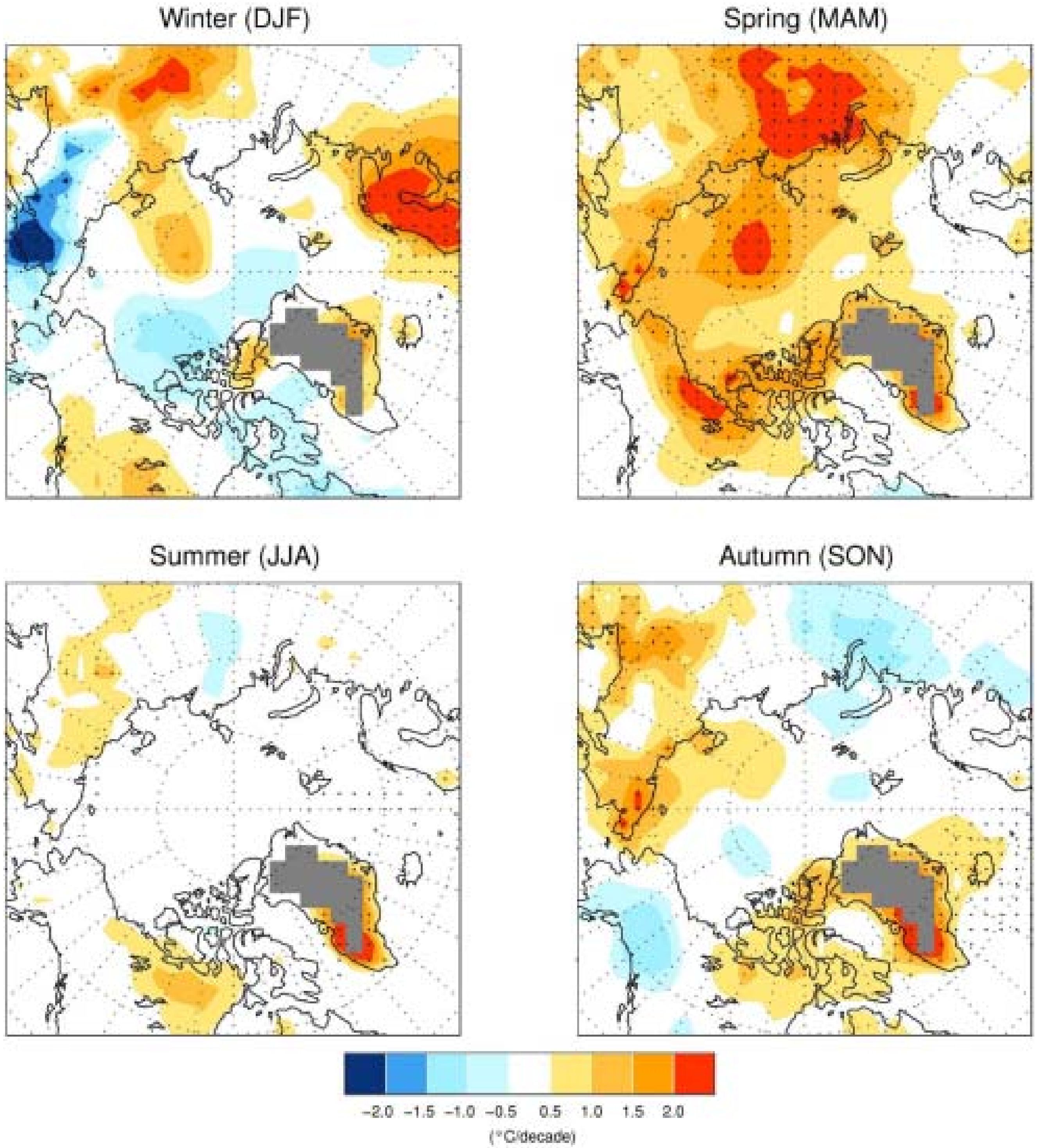

Figure 2. Trends in surface air temperature from 1979 – 1998 estimated from the IABP/POLES surface air temperature analysis. Trends in grid cells that are significant at the 95% level are marked with small black dots. A trend of +1°C/decade is found during winter in the eastern Arctic Ocean, but a trend of –1°C/decade is found in the western Arctic Ocean. During spring, almost the entire Arctic shows significant warming trends. In the eastern Arctic Ocean this warming is as much as 2°C/decade.